(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 357 382 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89308735.3

(22) Date of filing: 30.08.89

(51) Int. Cl.^{5}: D 21 D 5/16

(30) Priority: 31.08.88 FI 884001

(43) Date of publication of application: 07.03.90 Bulletin 90/10

(84) Designated Contracting States: AT DE FR GB SE

(71) Applicant: A. Ahlström Corporation
SF-29600 Noormarkku (FI)

(72) Inventor: Lassila, Jouko
Eestiläistentie 4 D
SF-02270 Espoo (FI)

(74) Representative: Gilmour, David Cedric Franklyn et al
POTTS, KERR & CO. 15 Hamilton Square
Birkenhead Merseyside L41 6BR (GB)

(54) Screen cylinder and method of manufacture.

(57) The present invention relates to a screen cylinder and a method of manufacturing thereof. The method and the screen cylinder according to the invention are especially suitable for treating fiber suspensions of the pulp and paper industry.

Screen plates of the prior art are mainly manufactured by manual welding, whereby the dimensional accuracy of the cylinders has been low and, because of the welding method used, the cylinder has had to be finish machined after assembly.

The method of the invention is characterized in that the screen cylinder is assembled into a single package comprising cylindrical screening sections, clamping rings and end rings, which are ready finished as to their dimensional accuracy and surface quality, said parts being then compressed by means of a special tool and welded together, preferably by a laser welding method, in one working stage.

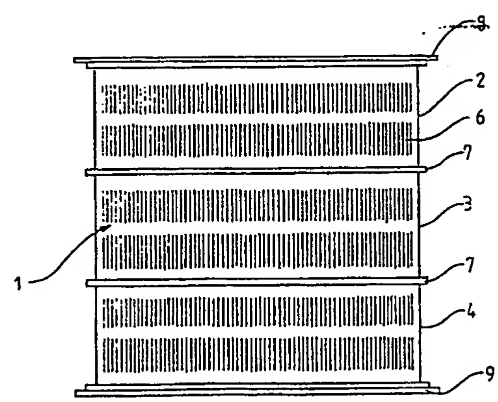

FIG. 1

EP 0 357 382 A2

Description

Screen cylinder and method of manufacture

The present invention relates to a screen cylinder and especially to a method of manufacturing thereof. The screen cylinder manufactured by the method according to the invention is especially suitable for screening fiber suspensions of the pulp and paper industry.

The prior art includes a great number of various methods of manufacturing screen cylinders. For example, US patent specification 2,850,165 (A. Hesse et al) discloses a screen cylinder comprising a great number of axial rods with screening slots therebetween, both ends of said rods being supported in grooves, thereby enabling adjusting of the distance between the rods, i.e. the slot width. The radial support is secured by arranging a few clamping rings equally spaced inwardly from said rods, against which rings the rods are clamped by means of strips outside the rods. The manufacturing process of such screen cylinders is very slow and complicated and consequently also expensive. Furthermore, the complicated support structure makes them unnecessarily heavy and their strength does not meet today's requirements.

As another example can be mentioned the arrangements according to US patent specifications 2,983,379 (H. G. Cram) and 3,561,605 (D.M. Likness), where the drum is formed by winding metal band, which is round or, for example, square in diameter,spirally against substantially axial support rods. The support rods may be disposed either outside or inside the spiral band which is attached to the support rods by, for example, welding. The structure is considerably lighter in comparison with the one described above, but still awkward and slow to manufacture, and it does not meet the strength requirements of today either. Furthermore, this method is not appropriate to making narrow slots to the present day requirements because the demands set on dimensional accuracy are very strict.

Furthermore, DE patent application 30 15 370 (W. Musselmann) discloses a structure of a screen drum assembled by piling a great number of rings, made by winding a wire of a certain cross-sectional shape, on top of each other leaving a slot of a certain dimension therebetween, said slot being formed by intermediate members and being relatively easy to adjust to a desired dimension with said intermediate members. The manufacture of the drum is, however, not even in this case very simple because the drum is composed of a great number of separate parts, which have to be assembled and fixed together tightly.

The prior art also includes a number of screen cylinder arrangements, in which the screen surface itself is a flat plate, which is expediently bent to form the screen cylinder. The most common way of manufacturing screen plates and cylinders therefrom is such that the plate is perforated and finished to the maximum prior to bending thereof, whereby it is easy to give the desired direction and shape to the perforations or slots to be machined unless the deformations caused by bending of the plate are counted. Hitherto, it was common to assemble a screen cylinder from a number of relatively small, bowed pieces of plate. In such cases, a separate screen body was usually needed to which the bowed pieces of plate were attached by welding, riveting or by some other appropriate manner. Obvious drawbacks of such manufacturing method are, however, on one hand the many stages of the manufacture and on the other hand, the relatively small open area of the screen cylinder, all junctions of the plates decreasing the otherwise efficient screening surface of the screen cylinder. The next stage was to attempt the assembly of a screen cylinder from as few as possible ready-machined bent plates, whereby it was finally possible to dispense with the screen body and to weld the bent plates together. In this manner, a cylinder was produced that was sufficiently strong for most purposes.

The simplification of the manufacture to the utmost has resulted in that the screen drum is composed of only one plate, which most usually is ready machined in the form of a plate, then bent to a cylindrical shape and the edges welded together into a form of a drum. To save both material and energy required for the machining, it is also natural that the screen surfaces should be as thin as possible, which results in the strength of the drum being not adequate and the drum has to be provided with reinforcements.

The latest fabrication method is represented by arrangements disclosed in US patents 3,361,981 (D. L. G. Young), 4,111,373 (E. Holz) and 4, 264,438 (F. Frejborg), according to which the screen cylinder is assembled by, first bending the screen which has been machined in the plate-form into a cylindrical form, then welding the edges together and finally providing the screen surface with expediently axially spaced support rings, said support rings preventing the relatively thin screen surface from being deformed by pressure. US patent 4,111,373, Fig. 3 discloses a screen drum composed of three separate cylindrical sections which at and through the support rings are joined together. A corresponding screen drum is also disclosed in US patent specification 4,264,438, in which the drum comprises at least two cylindrical screening sections, with a stiffening ring, and more specifically a flange-like protrusion of the stiffening ring therebetween, said cylindrical screening sections being welded to said stiffening ring, nowadays with either MIG or TIG welding method. However, attachment by welding, especially with the above-mentioned welding methods, has drawbacks because the heat transferring to the piece during welding causes deformations and consequently, the finished cylinder in most cases has to go through a finishing-up treatment, where in most cases the rings thereof are turned and polished to their final dimensions. In the manufacturing method described in the above-mentioned patent, partly due to the welding method, the

stiffening rings have to be supported well in place and be bridged separately prior to actual tacking.

All screen drums described above and made of plate material are ready machined in the form of a plate before they are bent into a cylindrical form. However, US patent specification 3,664,502 (G. E. Nichols) discloses a screen drum and a method of manufacturing thereof, in which the plate is first bent into a cylindrical form and welded at its edges into a cylinder, and only after that it is machined, for example, perforated. According to said patent specification, several rows of slots are machined at a time in a cylinder so that the axial levels of the slots are parallel to each other. Thus, the whole surface of the cylinder is efficiently used, but the direction of most slots deviates a lot from the radial direction.

It is still noteworthy that the screen drums are made nowadays and have to be made also in the future on the basis of customers' orders because a great number of drums are delivered to various manufacturers' equipment. This means that the dimensioning has to be based on said manufacturers' dimensioning defined for the body and rotor of the equipment. Consequently, following the present practice, the drum manufacture will take a long time because all possible dimensions cannot be made ready in stock, but the fabrication of each drum has to be started practically out of nothing. Therefore, in order to shorten the customers' time of waiting, the drum fabrication has to be made as quick as possible requiring as few working stages as possible.

The object of the invention is especially to rationalize the manufacture of screen cylinders in such a way that the end rings and clamping rings of the screen cylinder can be attached to the cylinder exactly where desired without prior bridging or setting, and also be fixed reliably without a risk of deformation of the cylinder due to excessive heat transfer. The latter problem has been solved by taking laser welding into use. In the laser welding, the heat amount transferring through the weld seam to the piece being welded only ranges from a fifth to a tenth of the heat amount transferring in the MIG and TIG welding. However, the laser welding brings about a problem to the existing method of manufacture. Earlier the manufacture of cylinders, even if the cylinders had been made in accordance with US patent 4,264,438, was mainly manual because the welding speed with the methods used at that time was relatively low, ranging from 20 to 30 cm/min. In the laser welding, however, the speed is about ten times the speed mentioned above, which means that it is no longer reasonable to manually assemble the cylinder piece by piece. The manufacture can be essentially speeded up by first assembling the cylinder, including its end rings and clamping rings, and thereafter weld it, for example, under control of a microprocessor, whereby the entire welding process can be automatized and the cylinder fabrication be speeded up to the maximum.

The method and apparatus according to the present invention has been developed to eliminate or minimize the drawbacks described above and to optimize the manufacture of screen cylinders.

The method according to the invention is characterized in that the exact disposition of the clamping rings on the cylinder surface is secured by assembling the cylinder of several cylindrical sections wherebetween the clamping rings are inserted. Thus, on one hand, the wear of the cylinder material can be better controlled because the cylinder is assembled of smaller cylindrical sections and, on the other hand, the clamping rings are disposed exactly in place at once, not being necessary to be separately bridged in place prior to final welding, which was compulsory when the claimping rings were fixed around a finished, plain cylinder or alternatively inside thereof.

Furthermore, the laser welding gives a higher manufacturing accuracy than the earlier methods because, firstly, the heat transferring to the piece during welding does not deform the piece and, secondly, the laser itself requires a high accuracy in alignment of the pieces to be welded. For example, with laser the width of the air slot between the pieces shall be 0.2 mm at most, otherwise the pieces are not hit by the laser beam at all. Correspondingly, the disposition accuracy of the laser is about 0.3 mm.

A still further advantage achieved by the present invention is that the screen cylinder can be assembled of sections that have been ready machined to the final surface quality and dimensional accuracy, whereby the ordinary procedure of finishing-up machining after welding can be avoided.

The method of the invention is further characterized in that the screen cylinder is assembled by arranging cylindrical screening sections and clamping rings one after another in turn and by providing the cylinder ends with end rings as to receive a desired length of the screen cylinder, whereafter the parts of the screen cylinder are compressed and welded together in one working stage.

A tool used in the method of the invention is characterized in that it comprises a piece provided with a surface of substantially rotational symmetry, said surface being arranged with steps whereupon the end ring of the screen cylinder lies during the manufacture of said screen cylinder.

A preferred embodiment of the screen cylinder manufactured by the method according to the invention is characterized in that the height of the flange of the clamping ring substantially equals the thickness of the screen plate.

The method and tool according to the invention and the screen cylinder manufactured by said method will be described more in detail in the following by way of example, with reference to the accompanying drawings, in which

Fig. 1 is an overall view of a screen cylinder manufactured by the method according to the invention,

Fig. 2 a...c illustrate a preferred embodiment of the junction between two cylindrical screening surfaces manufactured by the method of the invention,

Fig. 3 a...c illustrate a junction between the end reinforcement and the cylinder in the screen cylinder manufactured by the method of the invention, and

Fig. 4 illustrates a preferred embodiment of the tool for applying the method of the invention.

In accordance with Fig. 1, a screen cylinder 1 manufactured by the method of the invention comprises a plurality of cylindrical sections 2 - 4 disposed one after another, the screening openings 6 of which may be either similar to or different from one another. When carrying out the method according to the invention, it is possible either to fix clamping rings 7 of the screen cylinder simply and reliably between cylindrical sections similar to each other or to unite, by means of said clamping rings, cylindrical sections that are different from each other as to their contour or perforation. Furthermore, the method of the invention enables accurate and simple attachment of the end rings 8 and 9 within the area of the ends of the screen cylinder 1.

Fig. 2 illustrates some preferred embodiments for manufacturing a screen cylinder by uniting the cylindrical sections 3 and 4 with a clamping ring 7. The clamping ring shown in Fig. 2 a more or less corresponds to the embodiment disclosed in US patent 4,264,438, where welding may be effected from either the flange 10 of the clamping ring 7, the height of which flange, unlike in said US patent, substantially corresponds to the thickness of the screen plate, to the end levels of the cylindrical sections 3 and 4 or from the clamping ring itself to the sides of the end faces of the cylindrical sections.

Fig. 2 b illustrates an embodiment in which the flange 10 of the clamping ring 7 is lower than the thickness of the screen plate. Consequently, the clamping ring can be welded on from either the slot between the cylindrical sections 3 and 4, whereby the cylindrical sections will also be welded together, or from the clamping ring itself to the sides of the end faces of the cylindrical sections. Fig. 2 c illustrates a further embodiment, in which the cross section of the flange 10 of the clamping ring 7 is triangular, whereby the end faces of the cylindrical sections 3 and 4 need only to be bevelled correspondingly to ensure a good fit. Fixing is effected as in the embodiment of Fig. 2 b. It is also noteworthy that the clamping rings described above are applicable both inside and outside of the drum.

Fig. 3 illustrates various alternatives of disposing the end rings of the screen cylinder. In Fig. 3a, a corner of the end ring 8 is provided with a notch 11 for the screen cylinder 1, said notch abutting against the cylinder both axially and radially. In Fig. 3 b, the end of the cylinder 1 has a notch 12 and the end ring has a corresponding flange 13, whereby both axial and radial support are provided. In Fig. 3 c, a side of an end face of the cylinder 1 has a cut-out 12, in which the end ring 8 is disposed. Hereby, both axial and radial support is provided. It is only essential to the different alternatives of supporting, that there is provided locking into a certain form between the end ring and the screen cylinder in such a manner that when the cylinder is pressed from the opposite ends thereof, the entire cylinder block holds together, thereby being easy to automatically weld into a whole from the outside. With the above method a considerably higher dimensional accuracy is achieved than in the manual fabrication.

Fig. 4 illustrates a tool 15, by which the cylinder is compressed from the opposite ends thereof. The tool 15 mainly comprises a tapered piece, the tapered surface of which is provided with steps. The piece is axially rotatable for welding. Preferably, the steps of the tool sum to a diameter of three millimeters so that, with three pairs of tools, it is possible to fabricate a series of cylinders the diameters of which grow by one millimeter step by step. In Fig. 4, the end section of the screen cylinder according to the embodiment of Fig. 3 a is shown by a dash line. It can be seen that the cylinder is supported at its end ring by a tool, whereby locking into a fixed form is provided already at the end rings. The clamping rings are also disposed according to corresponding lockings into fixed forms respective to the cylindrical screening sections. In other words, the screen cylinder is so fabricated that on top of the tool is disposed an end ring of the desired dimension, said end ring matching the step of the tool exactly. Onto the end ring, there is disposed a desired number of cylindrical sections and clamping rings one on top of the other in turn, and when the cylinder length meets the requirement, the other end of the cylinder will also be provided with an end ring and a tool on top thereof. The tools are tightened towards one another, a laser welding device is focused on its starting point, and the assembly welding of the screen cylinder will be effected automatically.

It will be appreciated on the basis of the above that a completely novel and quick method has been developed for manufacturing screen cylinders. Besides considerably shortening the delivery time of the screen cylinders, the method according to the invention does not involve the many stages of manufacturing and finishing that were required earlier because the new fabrication method on one hand decreases manual work and on the other hand does not conduct an unnecessarily high amount of heat to the screen cylinder thereby minimizing the deformation of the cylinder and making the earlier required finishing-up measures completely unnecessary. The above describes only one preferred embodiment and tool according to the invention, yet in no way intending to restrict the inventive scope of the invention from what is disclosed in the accompanying claims.

Claims

1. A method of manufacturing a screen cylinder comprised of a plurality of parts and being provided with end and/or clamping rings, characterized in that the screen cylinder is assembled by arranging cylindrical screening sections and clamping rings alternately, adjacent each other and by providing the cylinder ends with end rings so as to provide a desired length of the screen cylinder, whereafter the parts of the screen cylinder are subjected to a compression force and welded together in one working stage.

2. The method as claimed in claim 1, characterized in that the parts of the screen cylinder, i.e. cylindrical screening sections and clamping rings are assembled onto an end ring placed on a pressing tool so as to make the cylinder to a desired length, whereafter the other end of the cylinder is provided with an end ring and another pressing tool and the cylinder parts are pressed together and welded together in one working stage.

3. The method as claimed in claim 1, characterized in that the parts of the screen cylinder, i.e. cylindrical screening sections and clamping rings, which have been machined to their final form as to their surface quality and dimensional accuracy, are placed onto an end ring placed on the pressing tool in such a manner that the desired length of the drum is achieved, whereafter the other end of the drum is provided with an end ring and another pressing tool and the parts of the screen cylinder are pressed together and welded together in one working stage, whereby the final machining after welding is avoided.

4. A tool for manufacturing a screen cylinder, characterized in that it comprises a member or piece provided with a surface of substantially rotational symmetry, said surface having at least one step, upon which the end ring of the screen cylinder lies during the manufacture of said screen cylinder.

5. The tool as claimed in claim 4, characterized in that it comprises a piece provided with a substantially tapered surface, said tapered surface being arranged with steps, upon one of which steps the end ring of the screen drum lies during the manufacture of the screen cylinder.

6. The tool as claimed in claim 5, characterized in that the tapered surface is the outer surface of the tool, the piece itself being substantially tapered.

7. The tool as claimed in claim 5, characterized in that the tapered surface is the inner surface of the tool, the tool being provided with a tapered cut-out.

8. A screen cylinder manufactured by the method as claimed in claim 1, said screen cylinder comprising a plurality of end rings and clamping rings and cylindrical screening sections arranged therebetween, characterized in that the height of the flange (10) of the clamping ring (7) is substantially the same as the thickness of the screen plate (3, 4).

9. The screen cylinder manufactured by the method as claimed in claim 1, said screen cylinder comprising a plurality of end rings and clamping rings and cylindrical screening sections arranged therebetween, characterized in that the height of the flange (10) of the clamping ring (7) is substantially the same as the height of the cut-out machined in the screen plate.

10. A screen cylinder manufactured by the method as claimed in claim 1, characterized in that its end rings and clamping rings and cylindrical screening sections therebetween are shaped and/or dimensioned relative to each other so as to provide a stable assembly when pressed together by axial forces prior to welding.

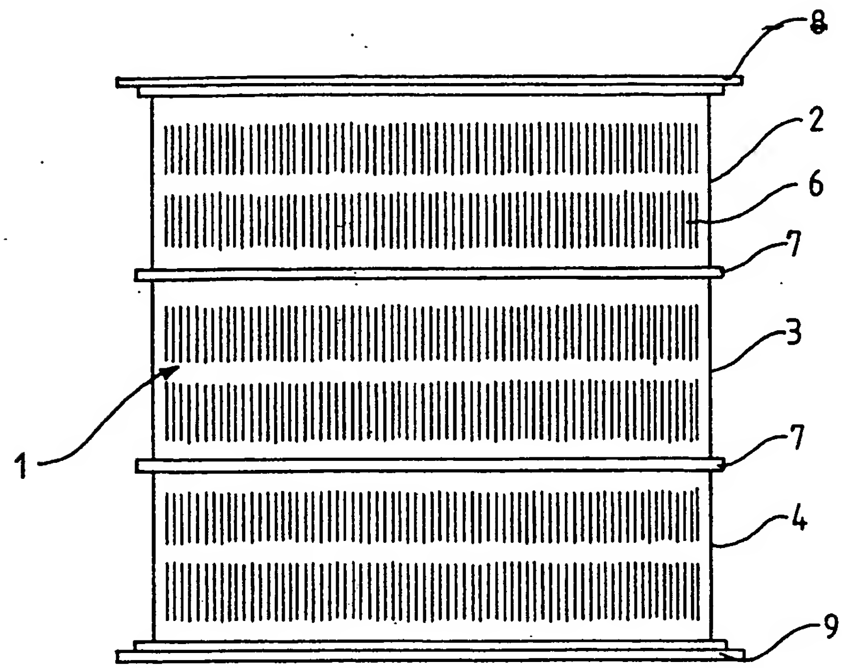

FIG. 1

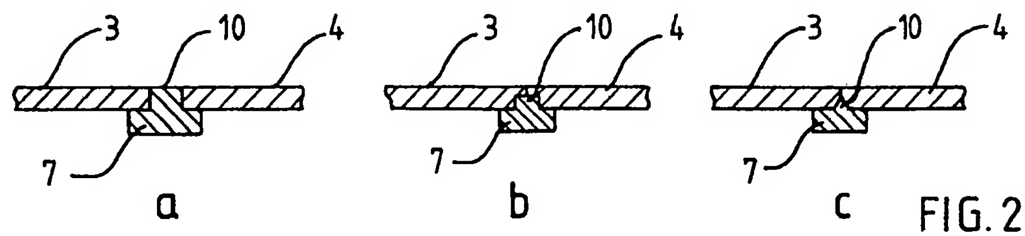

FIG. 2

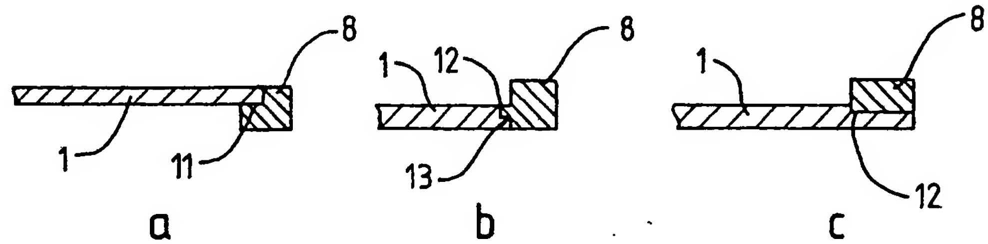

FIG. 3

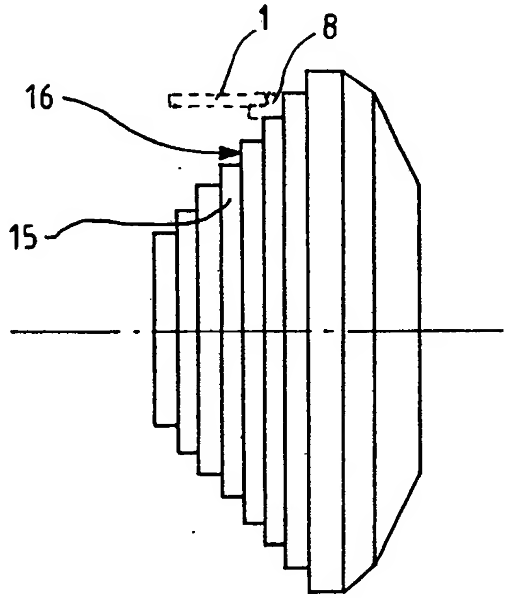

FIG. 4